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(71) Applicant
Glass Incorporated International (USA-California),
PO Box 2129, Covina, California 91722,
United States of America

(72) Inventors
Albert Lewis,
Cenek Kottnauer

(74) Agent and/or Address for Service
Phillips & Leigh,
7 Staple Inn, Holborn, London SW1V 7QF

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None

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(54) **Composition for making glass fibres**

(57) Fibre forming glass, suitable for, inter alia, insulating and reinforcing uses comprising (in wt %)

SiO_2	44 - 64
Al_2O_3	3 - 11
Na_2O	16 - 22
K_2O	<3
CaO	3 - 14
MgO	1 - 8
$FeO + Fe_2O_3$	3 - 10

and can also contain TiO_2 (<1.9 wt %), ZnO, MnO, BaO, SiO, SO_3 etc.

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SPECIFICATION

Glass compositions

Glass products have been produced in the past by various methods from slag, fusible rock, zeolite and various other raw materials. These materials have been processed into many commercial products such as high wear resistant material building tile, glass ceramics, mineral fibres etc. Various techniques have been used to produce these products. Although the glass compositions of this invention can be used to make a wide variety of glass products, the manufacture of glass fibres for reinforcements and insulation are more fully described herein. It is not intended to limit this disclosure to fibre products only. Fibres are produced by flame attenuation and/or centrifugal rotary forces which attenuates the glass into fine fibres.

Glass compositions used with the above processes must have physical properties which make it possible to use the glass in the process. The rotary process involves delivering into a high speed rotating disc a high temperature liquid glass. The glass is then caused to flow through the openings in the periphery of the disc. An annular blast from a burner causes the fibre to be further attenuated. We have developed these low cost glass compositions for commercial products. These glasses can be formulated with viscosity and liquidus temperatures suitable for commercial production by several processes. In particular it has been found that the disclosed glasses can be formed into fibre for both insulation and reinforcements. The fibres can be produced using continuous attenuation, flame attenuation and the rotary disc or mineral wool spinner.

These glasses obtain unique characteristics as a result of having a large amount of iron oxide in combination with the other glass batch ingredients given below. It was learned that both the viscosity and liquidus temperatures can be lowered using iron oxide in the batch without adversely affecting chemical durability.

Range of glass compositions

Glass compositions of this invention have the following compositional range:

Oxides	*Weight Percent*
SiO_2	44.0 – 64.0
Al_2O_3	3.0 – 11.0
Na_2O	16.0 – 22.0
K_2O	0.0 – 3.0
CaO	3.0 – 14.0
MgO	1.0 – 8.0
FeO and Fe_2O_3	3.0 – 10.0
TiO_2	0 – 1.9

More preferably, these glass compositions are as follows:

Oxides	*Weight Percent*
SiO_2	57.0 – 64.0
Al_2O_3	3.0 – 5.0
Na_2O	16.0 – 20.0
K_2O	0 – 2.5
CaO	4.0 – 10.0
MgO	1.5 – 6.5
FeO & Fe_2O_3	3.0 – 8.0

Various impure materials may be present in the glass compositions without adversely affecting the glasses or fibres. These impurities can include up to several percent by weight of SO_3, SrO, BaO, etc.

Typical composition

Oxides	*Weight Percents*						
SiO_2	61.0	61.0	61.0	61.0	59.2	59.5	59.5
Al_2O_3	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Na_2O	20.0	18.0	19.0	21.0	17.0	19.0	20.0
K_2O	0.3	0.2	1.4	2.5	1.3	1.3	1.0
MgO	1.6	4.4	3.7	2.9	5.0	4.0	4.0
CaO	7.6	7.0	5.4	4.5	8.0	6.7	6.0
B_2O_3	–	–	–	–	–	–	–
Fe_2O_3	–	–	–	–	–	–	–
FeO/Fe_2O_3	4.2	4.2	4.2	4.2	4.2	4.2	4.2
TiO_2	0.8	0.8	0.8	0.8	0.8	0.8	0.8
for log							
n = 2.5	2182	2191	2181	2163	2138	2125	2109
liquidus	1852	1655	1655	1617	1883	1694	1716
T (Deg.F)							
Chemical Durability (% weight loss in 24 hours)							
H_2O	1.76	2.75	4.07	4.99	1.48	3.13	3.16
10%	7.56	5.77	7.78	13.50	6.61	8.20	8.28
H_2SO_4							

The glass compositions of this invention have a liquidus temperature of 2100 degrees F. and a viscosity of 10(2.5) poises at 2150 degrees F. These glasses are therefore suitable for glass forming. The glasses of this invention, with a large amount of iron oxide, seems to improve chemical durability.

The batch can be melted in a state-of-the-art fossil fuel or electric furnace. Because of the dark colour of the glass, heat transfer through the glass is less efficient than clear glasses. Therefore, the use of some electrical heating by submerged electrodes may be desirable when using a fossil fuel furnace. The molten glass may be formed into several commercial glass products, but most particularly it can be formed into glass fibre using the continuous attentuation, flame attenuation, rotary disc and mineral wool processes.

A method of making a glass fibre product involves forming the glass fibres from a molten stream of glass and combining the glass fibres with a heat curable aqueous binder. The economical method for manufacturing glass fibre is the rotary process for insulation products and continuous or staple fibres for reinforcements. For insulation products the combination of glass fibres and heat curable binder is gathered on a conveyor. It is normally compressed to increase its density and heated to cure the binder on the glass fibres to form the desired product. If processed into continuous fibre the fibres are drawn from a multiple hole platinum alloy bushing at speeds up to 10,000 FPM. An aqueous binder is applied as the glass is wound onto a paper covered mandrel. Following the winding operation the glass coated with a binder is cured in an oven at a temperature of 250 degrees F. Stape fibre may also be made by either the rotary or drum process using the disclosed glasses.

The above glass compositions can be used in the rotary process where the operating temperature is relatively low. This reduces the erosion and oxidation of the disc. The low operating temperatures are the result of the disclosed glass compositions.

CLAIMS

1. Glass fibres containing the following range:

Oxides	*Weight Percent*
SiO_2	56.0 – 64.0
Al_2O_3	3.0 – 6.0
Na_2O	16.0 – 22.0
K_2O	0 – 2.0
CaO	3.0 – 14.0
MgO	1.0 – 7.0
FeO & Fe_2O_3	4.1 – 10.0

Other oxides that may be included are TiO_2, ZnO, SO_3, MnO, SrO, BaO etc. They have a viscosity of log n = 2.5 at a temperature of about 1260 degrees C. and a liquidus temperature of about 1100 degrees C.

2. Glass fibres consisting essentially of, by weight:

Oxides	*Weight Percent*
SiO_2	57.0 – 64.0
Al_2O_3	3.0 – 5.0
Na_2O	16.0 – 20.0
K_2O	0 – 1.5
CaO	4.0 – 10.0
MgO	1.5 – 6.5
FeO & Fe_2O_3	4.1 – 8.0

Other oxides that may be included are TiO_2, ZnO, Li_2O, BaO etc. They have a viscosity of log n = 2.5 at a temperature of about 1250 degrees C. or less and a liquidus temperature of about 1100 degrees C. or less.

3. Glass fibres containing the following:

Oxides	*Weight Percent*
SiO_2	61.0
Al_2O_3	4.5
Na_2O	20.0
K_2O	0.3
CaO	7.6
MgO	1.6
FeO & Fe_2O_3	4.2
TiO_2	0.8

4. Glass fibres containing the following:

Oxides	Weight Percent
SiO_2	61.0
Al_2O_3	4.5
Na_2O	18.0
K_2O	0.3
CaO	7.0
MgO	4.3
FeO & Fe_2O_3	4.2
TiO_2	0.8

5. Glass fibres containing the following:

Oxides	Weight Percent
SiO_2	61.0
Al_2O_3	4.5
Na_2O	19.0
K_2O	31.3
CaO	5.5
MgO	3.7
FeO & Fe_2O_3	4.2
TiO_2	0.8

6. Glass fibres containing the following:

Oxides	Weight Percent
SiO_2	61.0
Al_2O_3	4.5
Na_2O	21.0
K_2O	2.5
aO	4.5
MgO	2.9
FeO & Fe_2O_3	4.2
TiO_2	0.8

7. Glass fibres containing the following:

Oxides	*Weight Percent*
SiO_2	59.2
Al_2O_3	4.5
Na_2O	17.0
K_2O	1.3
CaO	8.0
MgO	5.0
FeO & Fe_2O_3	4.2
TiO_2	0.8

8. Glass fibres containing the following:

Oxides	*Weight Percent*
SiO_2	59.5
Al_2O_3	4.5
Na_2O	19.0
K_2O	1.3
CaO	6.7
MgO	4.0
FeO & Fe_2O_3	4.2
TiO_2	0.8

9. Glass fibres containing the following:

Oxides	*Weight Percent*
SiO_2	59.5
Al_2O_3	4.5
Na_2O	20.0
K_2O	1.0
CaO	6.0
MgO	4.0
FeO & Fe_2O_3	4.2
TiO_2	0.8

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